UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WASHINGTON, D. C.
H. H. BENNETT, CHIEF

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF HURLEY LAKE

GETTYSBURG, SOUTH DAKOTA

June 9-24, 1937

By

Louis M. Glymph, Jr.

Sedimentation Studies
Division of Research
SCS-SS-26
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In cooperation with

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Brookings, South Dakota
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INTRODUCTION

This report is one of a series of advance reports on reservoir silting investigations made by the Section of Sedimentation Studies, Division of Research, Soil Conservation Service. Each reservoir survey is part of a Nation-wide study of the condition of American reservoirs with respect to storage reduction by silting. The ultimate objective of these studies is to determine rates and causes of reservoir silting, in order to derive a practical index (1) to the useful life expectancy of existing or contemplated reservoirs, and (2) to differences and changes in regional erosion conditions as influenced both by natural factors and by land use.

The sedimentation survey of Hurley Lake was made by the Section of Sedimentation Studies, Division of Research, Soil Conservation Service, during the period June 9-24, 1937. The field party consisted of L. M. Glymph, Jr., party chief, A. B. Taylor, E. H. Moser, Jr., Harold New, Jonas Spitler, and Duncan Axford. F. L. Duley, field representative of the Research Division, aided in arranging cooperative agreements and in coordinating the field program.

Volume-weight relations of samples of reservoir sediment were determined by the hydraulic laboratory unit of the Section of Soil and Water Conservation Experiment Stations, Division of Research, at Washington, D. C.

The Soil Conservation Service wishes to acknowledge the cooperation of the various State and county agencies, particularly the South Dakota Game and Fish Department, in authorizing the survey. Dean W. Lauchs, State engineer, furnished general information on reservoirs in the State as a whole that proved most helpful during early reconnaissance investigations. Mr. Lyle K. Kennedy, Potter County agricultural agent, supplied land-use data and furnished office space for drafting during the survey. Acknowledgment is also made of the generous assistance of Messrs. Fred Bartel and Ralph Johnson during a reconnaissance of stock ponds in the drainage basin and for authorizing studies on their property.

GENERAL INFORMATION

Location (fig. 1).

State: South Dakota.

County: Potter, Secs. 28 and 29, T. 119 N., R. 77 W. (Appomattox Township).

Distance and direction from nearest city: 11.5 miles northwest of Gettysburg, S. Dak.

Drainage and backwater: Little Cheyenne Creek, a small intermittent stream that flows southwestward to join the Missouri River about 2 miles northeast of Forest City.

Ownership: State of South Dakota. Built under the auspices of the State Game and Fish Department with the cooperation of Potter County and the Reconstruction Finance Corporation.

Purpose served: Recreation and water conservation.

Description of dam.

The dam is an earth-fill structure extending northwestward across the narrow valley cut by Little Cheyenne Creek through the series of hills which border the east side of the Missouri River. The dam has a length of 750 feet, a maximum height above stream bed of 43 feet, and a crest thickness of 12 feet. The upstream face has a slope of 3:1 and is paved with a riprap of native stone; the slope of the downstream face is $1\frac{1}{2}$:1.

An independent concrete spillway, 40 feet wide and 35 feet above the stream bed, lies 75 feet south of the dam and is connected with the reservoir by an artificial channel about 250 feet long. For the purpose of this survey a local datum of 100 was assumed as crest elevation. A secondary spillway 100 feet wide and 770 feet long has been excavated about 250 feet north of the dam; it has a crest elevation 4 feet higher than that of the concrete spillway.

Date of completion: December 1932. Date of survey: June 1937.

Age: 4.5 years.

Length of lake: (Original and at date of survey): 2 miles. This length includes the ponded channel of Little Cheyenne Creek, which extends for approximately 1 mile beyond the main basin of the reservoir.

FIGURE I

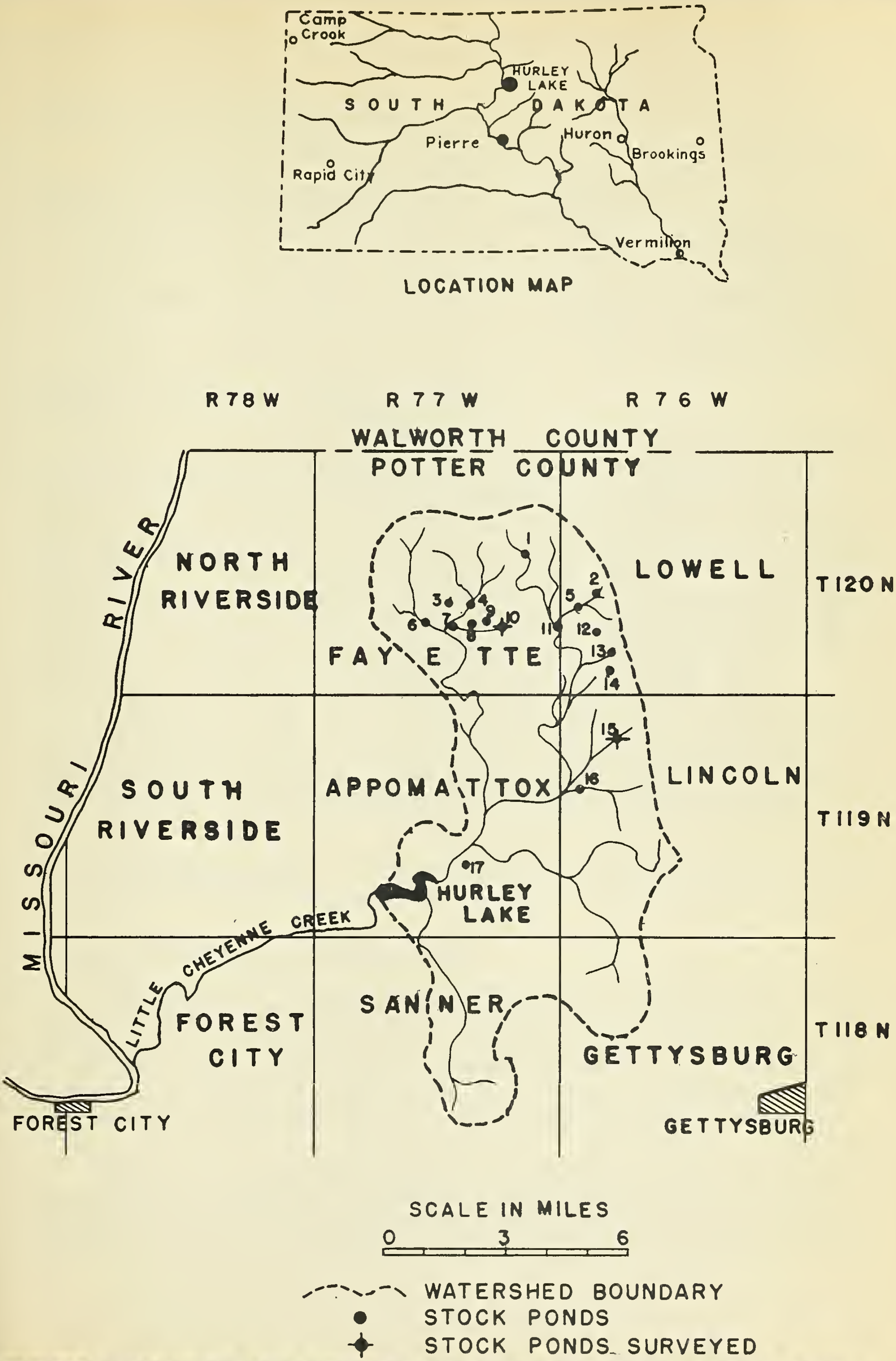

FIGURE I.-LOCATION AND GENERAL RELATION OF HURLEY LAKE AND ITS DRAINAGE BASIN.

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Area of lake at spillway stage:

Original and at date of survey........................ 120 acres

Storage capacity to spillway level:	Acre-feet	
Original..........................	1,226	(399,492,100 gals.)
At date of survey................	1,189	(387,435,650 gals.)
Loss by sedimentation............	37	(12,056,450 gals.)

General character of reservoir basin.

The basin of Hurley Lake may be considered in two parts; namely, a basin section and a channel section (fig. 2, following p. 17). The basin proper, which extends almost due east from the dam for about 1 mile, maintains an average width of approximately 865 feet and constitutes the main storage of the reservoir. Above this basin backwater is confined almost entirely to the channel of Little Cheyenne Creek, which extends north from the point of its juncture with the basin proper for about 3,600 feet. The ponded channel section then turns southeast and extends for about 2,000 feet before terminating at a barrier of loose water-worn glacial boulders.

Through the reservoir as a whole the submerged channel has an average gradient of 14.3 feet per mile. The gradient in the lower basin is 15.4 feet per mile, and in the ponded channel it is 13.1 feet per mile. In the lower basin the channel bottom is about 12 feet below the adjacent flood plain.

Area of drainage basin: 70 square miles, as determined from a county map revised by field reconnaissance.

General character of drainage basin.

Topography and drainage.--The Hurley Lake drainage basin lies in the Great Plains province, in the broad transition zone wherein these plains merge into the prairies of the Mississippi Valley, and just within the western edge of the glaciated section, a region whose topography is dominated by till plains amd moraines developed by a great ice sheet that advanced over the region in Pleistocene time.

The entire region is underlain by the Pierre shale, of Cretaceous age, but this formation is buried to depths of as much as 150 feet by calcareous glacial till, consisting generally of an unstratified mixture of clay, sand, pebbles, and boulders but including occasional

beds or pockets of stratified sand. The till is exceptionally clayey, because the ice that deposited it had moved over and deeply eroded the underlying Pierre shale for long distances. For the same reason boulders, mainly Laurentian granite and greenstone and fine-grained Silurian limestone, comprise probably less than 20 percent of the morainic material, although, because of subsequent erosion and the removal of finer material, they form a much larger proportion at the present surface.

Terminal moraines form the watershed divide around the entire area except for a short stretch on the southeast. Slopes within the encircling moraines descend more or less abruptly from the ridges for the first half mile and then flatten out into a broad, gently undulating plain along the major drainage course. Drainage of the area as a whole is well established, and the pattern is marked by many small draws. Depressions that form small natural lakes during rainy seasons are numerous along the crest of the divide.

Soils.--Soils in the area are characteristically dark brown and in general are highly productive. No soil surveys have been made in Potter County, but field observations show that there are three general soil type areas within the watershed. The soil of the east-central part of the drainage basin has a dark-brown to almost black topsoil and other characteristics that compare with the Williams silt loam as mapped in Walworth County.[1] In the northwestern part of the basin the surface soil decreases in thickness and changes in texture to clay. The soils here in general compare with the area in Walworth County that is mapped as Edgeley clay. Areas of rough stony land follow the moraine that borders the drainage basin. The chief characteristics of the rough stony land are the presence of many glacial boulders and the rolling to rough topography. The finely divided surface soil ranges in depth from 1 to 6 inches, and in texture from loam to clay.

Erosion conditions.--Both water and wind erosion are active in varying degrees within the area. Water erosion has been most active along the steeper slopes of the northeastern part where, in sections 29 and 32 of Lowell Township, limited areas are being seriously affected by advanced sheet erosion and subsequent deposition of the debris at the base of the slopes. Areas of most active wind erosion occur in the western part of the drainage basin. Zones of severely wind-eroded soils have been observed in sections 22 and 23 of Appomattox Township. Most of the rough stony land in the area is grass-covered and has not been seriously affected by accelerated erosion.

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[1] Machlis, J. A., and Larson, G. A. Soil Survey of Walworth County, South Dakota. U. S. Dept. Agr., Bur. Chem. and Soils, 1923.

Land use.--The Hurley Lake drainage basin lies in the transitional climatic zone of the Great Plains region, between the section of heaviest precipitation to the east and the semiarid country to the west. It is primarily an agricultural area but is necessarily subject to the crop hazards associated with its geographic location. The approximate proportionate areas of the drainage basin devoted to different types of land use during the year 1935 are shown in the following tabulation.[2]

	Percent
Cultivated:	
Corn	7.5
Wheat	15.0
Oats	4.0
Barley	6.0
Cane and millet	1.5
Flax	3.0
Total cultivated land	37.0
Wild hay	11.0
Pasture and native range	25.0
Idle	24.0
Farmsteads	3.0
Total drainage area	100.0

With the possible exception of some variation in the yearly percentage of idle and cultivated land, it is believed that the above tabulation closely represents the average land use during the history of the lake. With the return of more favorable rainfall conditions, perhaps much of the idle land will again be devoted to cultivated crops.

Mean annual rainfall: Approximately 17.17 inches, according to records of the United States Weather Bureau at Eales and Gettysburg, S. Dak.

Evaporation: About 31 inches per year on open water, according to records of the United States Weather Bureau.

[2]Assembled from data on file in the office of the Potter County agricultural agent.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

METHOD OF SURVEY

The original and remaining capacities and the volume of sediment in Hurley Lake were determined by the range method of survey.[3] A triangulation network of 13 stations was expanded from a 970-foot base line and served as control for shore-line mapping. Twenty-nine silt ranges were established, sounded, and spudded, and all range ends and cut-in stations and the more important triangulation stations were marked with iron pipe stamped with the station numbers and set in concrete. Mapping was done with plane table and telescopic alidade on a scale of 1 inch to 200 feet.

Although the total capacities were determined by the range method, the sounding data were used to draw 1-foot contours on the silt surface, and from these contours the accompanying capacity chart was prepared (fig. 3).

In addition to the work on Hurley Lake detailed studies were made on two stock ponds within its watershed. The stock ponds were mapped on a scale of 1 inch to 50 feet and the original and remaining capacities and silt volumes in each were determined by the contour method of survey.[4] Watershed and land-use boundaries of the stock-pond drainage basins were mapped by plane table on a scale of 1 inch to 1,000 feet.

Five samples of bottom sediment were taken at five locations distributed from the dam to midway up the ponded channel section of Hurley Lake, and three samples were taken in each of the stock ponds. A special tubular sampler, described in an earlier report,[5] was used in taking the sediment from the basins so that it could be preserved in the wet condition. The volume-weight relations of the samples have been determined by laboratory methods and the results are incorporated in this report (table 3, p.15)

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[3]Eakin, H. M. Silting of Reservoirs. U. S. Dept. Agr. Tech. Bull. 524: 129-135, 1936.

[4]Eakin, H. M. Silting of Reservoirs. U. S. Dept. Agr. Tech. Bull. 524: 135-136, 1936.

[5]Jones, V. H. Advance Report on the Sedimentation Survey of Lake Bracken, Galesburg, Ill. U. S. Soil Conserv. Serv., SS-14, p. 7, May 1937. (Mimeographed.)

SEDIMENT DEPOSITS

Character of Sediment

The sediment of Hurley Lake is characterized by a diversity of texture, ranging from coarse sand, confined in general to the narrow channel section, to silt and clay in the basin proper. The coarse sediment in the ponded-channel section contains a high proportion of partly decayed organic matter. Its color ranges from light brown to black, being determined largely by the amount of included organic matter and the extent of its decomposition. The sediment deposits in the lower half of the reservoir consist predominantly of silt and contain only occasional particles of organic material. The silt ranges from light to dark brown, being generally of lighter shades than the sediment of the ponded channel.

Wave erosion is active along the south shore and has supplied an unknown amount of sediment, the bulk of which has accumulated as a narrow, discontinuous beach along the prevailing shore line. On ranges R3-R4, R8-R9, R10-R11, R16-R17, R18-R20, and R21-R22, where the submerged stream channel impinges upon the valley sides, a considerable amount of wave-erosion debris has been rolled into the channel and mixed with the finer sediment. Since the beach level is largely determined by the stage of water in the basin, the extent of this rolling and mixing of sediment varies with fluctuations of the water level.

Pre-lake deposits.

In the lower half of the reservoir, the sediment on the submerged valley slopes and old flood plain is underlain by a thin layer of clay loam soil. Within the relatively narrow stream channel in this section bottom material was observed to be either a grayish-brown clay mixed with fine gravel and particles of shale, or an almost pure river sand containing varying amounts of fine gravel. In the upper half of the reservoir the bottom of the lake deposit is defined by several distinct materials; on range R18-R21 a layer of twigs, leaves, and roots about 0.2 foot thick was observed just below the sediment; on range R28-R29 the bottom material is a black alluvial soil containing an abundance of decaying organic matter; and on range R28-R30 the sediment is underlain by a light-brown sand. Mixtures of stream-deposited sand and gravel were found to underlie the sediment at the deepest place on each range in the upper segment of the reservoir.

Distribution of Sediment

Sediment in the reservoir was more or less evenly distributed from the dam upstream to range R40-R41, beyond which silt occurred only locally and in negligible quantities. (See fig. 4.) Maximum depths were found in the submerged stream channel, but only a thin layer occurred on the adjacent terraces. The maximum depth was constant at 1.9 feet on the first four ranges above the dam, but decreased gradually although discontinuously on successive ranges upstream.

Many intermittent streams, including Little Cheyenne Creek, have gouge holes along their courses, and it is possible that such depressions are responsible for the irregular silt depths encountered in the reservoir.

SUMMARY

The detailed sedimentation survey of Hurley Lake revealed an average annual accumulation of 8.2 acre-feet of sediment, equivalent to about 8 cubic feet per acre of drainage area. If the average dry weight of the reservoir sediment is 40.9 pounds per cubic foot,[6] and that of the soil in the drainage area is 79.5 pounds per cubic foot,[7] the measured rate of sedimentation indicates that the time required to remove 1 inch of soil from the entire area by water erosion is at most about 880 years.[8] This is an exceptionally low rate of erosion, compared with other areas on which similar studies have been made.

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[6]See table 3, page 15.

[7]Based on the volume weights of samples from the surface and the two upper horizons of silt loams and clay (corresponding to the principal soil types of this area) given by Middleton, H. E., Slater, C. S., and Byers, H. G. The Physical and Chemical Characteristics of the Soils from the Erosion Experiment Stations--Second Reports. U. S. Dept. Agr. Tech. Bull. 430: 21, 1934.

[8]This figure does not allow for the considerable but indeterminate amount of sediment that has been bypassed through the reservoir.

A complete summary of the results of the sedimentation survey is given in the following tabulation.

Summary of data on Hurley Lake, Gettysburg, S. Dak.

	Quantity	Unit
Age[1]	4.5	Years
Watershed area[2]	70.0	Square miles
Reservoir:		
Area at spillway stage:		
Original and at date of survey	120	Acres
Storage capacity to spillway level:		
Original	1,226	Acre-feet
At date of survey	1,189	Acre-feet
Capacity per sq. mile of drainage area:[2]		
Original	17.51	Acre-feet
At date of survey	16.99	Acre-feet
Sedimentation:		
Total sediment	37	Acre-feet
Average annual accumulation:		
From entire drainage area	8.2	Acre-feet
Per 100 sq. miles of drainage area[3]	11.8	Acre-feet
Per acre of drainage area:[3]		
By volume	8.02	Cubic feet
By weight (assuming 1 cubic foot of silt weighs 40.9 pounds)[4]	0.16	Ton
Depletion of storage:		
Loss of original capacity:		
Per year	0.67	Percent
To date of survey	3.02	Percent

[1]Storage began December 1932; average date of survey, June 1937.
[2]Including area of lake.
[3]Excluding area of lake. This correction is of little significance, however, as it is probably within the limit of accuracy of the watershed area.
[4]Determined from 5 samples (table 3, p. 15).

STOCK PONDS

A dependable water supply for stock in the Great Plains region has been a matter of deep concern, especially during the serious drought of the last several years, and the 17 stock ponds in the Hurley Lake drainage basin have been of great value in this respect. These ponds have an estimated combined surface area of 34.3 acres and a combined storage capacity of 80.7 acre-feet; and they intercept drainage from approximately 8,550 acres, or 19 percent of the total drainage area. Table 1 gives the approximate size and drainage area of each pond.

Table 1.--Stock ponds in the Hurley Lake drainage basin

Location number[1]	Surface area[2]	Storage capacity[2]	Drainage area[2]
	Acres	Acre-feet	Acres
1	2.0	3.0	500
2	.9	2.7	300
3	1.0	2.5	160
4	.5	1.0	960
5..................................	4.0	8.0	400
6	2.2	4.4	1,600
7	1.1	2.2	200
8	.3	.6	28
9	2.7	4.0	80
10[3]..................................	1.5	2.6	122
11	2.0	4.0	2,000
12	1.5	2.6	200
13	1.0	5.0	80
14	1.1	3.3	100
15[4]..................................	2.0	4.3	390
16	10.0	30.0	1,280
17	.5	.5	150
Total	34.3	80.7	8,550

[1]For locations see figure 1 (following p. 2).
[2]All figures except those on the Bartel and Johnson stock ponds are estimates.
[3]Ralph Johnson's stock pond. Figures based on detailed survey.
[4]Fred Bartel's stock pond. Figures based on detailed survey.

A reconnaissance examination of these ponds revealed that the original storage capacity of many of them has been somewhat depleted through the accumulation of sediment and indicated that they may trap an appreciable amount of sediment that would otherwise reach Hurley Lake.

Detailed surveys of two representative ponds were made in an effort to evaluate the gross effect of all the stock ponds on sedimentation in the main lake. These surveys, furthermore, establish a basis for comparing the rates of sediment production or net erosion from the smaller drainage basins with that from the entire area above Hurley Lake.

In selecting the stock ponds for detailed survey, a field reconnaissance examination was made of the entire Hurley Lake drainage basin and of all the stock ponds, in order to determine which of the small storage basins above Hurley Lake would be most representative with regard to silting conditions and character of drainage basin. A maze of interrelated factors, including both natural and man-induced conditions in the drainage area, as well as climatic factors, combine to determine the rates of erosion and consequently the quantities of erosional waste available for stream sediment loads and subsequent deposition. These factors were recognized as having a bearing upon the validity of the selection and, finally, upon the value of the results obtained through the surveys.

In addition to factors affecting the drainage basin, consideration was also given to the physical characteristics of the individual basins and to their history. The study of stock ponds in the area revealed that several of the dams had been washed out one or more times, and that unknown quantities of sediment had been washed from the basins during the periods when the dams were out. In other reservoirs, sediment has been removed from the basins by "drag-pans" or "fresnos" when the ponds were partly or completely dry.

With these many factors under consideration, two ponds were selected for survey whose drainage basins, taken together, are believed to represent the general average of slope and land-use conditions in the Hurley Lake drainage basin as a whole.

Fred Bartel's Stock Pond

Location: NE $\frac{1}{4}$ sec. 8, T. 119 N., R. 75 W., Potter County. Approximately 7 miles northeast of Hurley Lake, on a small southwest-flowing tributary of Little Cheyenne Creek.

Ownership: Fred Bartel.

Purpose served: Water supply for range stock.

Description of storage basin.

Backwater extends for 700 feet above an earth-fill dam which is 175 feet long and rises 11 feet above stream bed (fig. 5). The spillway was excavated around the west end of the dam and is 4 feet below its crest. Sediment has accumulated over the entire bottom of the pond and is 5.0 feet thick just above the dam. In a small area at the upper end of the basin, sediment deposits extend above crest level.

Description of drainage basin.

The land draining into this pond lies in the northeastern part of the Hurley Lake drainage basin and is typical of the rough stony land in the larger area. Slopes are steep, drainage is well developed, and the maximum relief is about 150 feet. Watershed and land-use boundaries were mapped by a plane-table traverse around the area. The total watershed area was determined to be 390 acres. Of this area 367 acres is in grass, the sod of which has never been broken, and the remaining 23 acres has been plowed only twice in the last 10 years (fig. 5, insert).

Ralph Johnson's Stock Pond

Location: NE$\frac{1}{4}$ sec. 26, T. 120 N., R 77 W., Potter County. Approximately 7.2 miles north-northeast of Hurley Lake, on a small westward-flowing tributary of Little Cheyenne Creek.

Ownership: Ralph Johnson.

Purpose served: Water supply for range stock.

Description of storage basin.

Backwater extends for 500 feet above an earth-fill dam which is 285 feet long and rises about 7 feet above the valley floor (fig. 6). The basin is shallow and--with the exception of a small area immediately above the dam, where excavation was made during construction--is very regular in configuration. Flood water follows a natural spillway around the west end of the dam and spreads evenly over the valley floor. Sediment has accumulated over most of the basin and has a maximum thickness of 2.4 feet immediately above the dam. No sediment has accumulated at or above crest elevation.

General description of drainage basin.

The land draining into this pond lies in the northeastern part of the Hurley Lake drainage basin and represents one of the more highly cultivated sections. Its outer rim is determined by a series of hills which constitute an outlying portion of the moraine described earlier in this report, but the slopes in this area are gradual, and the maximum relief probably does not exceed 75 feet. The total watershed area was determined to be 122 acres, 92 acres of which is in cultivation (fig. 6, insert).

Summary of Survey Results

In each pond sediment volumes and the original and remaining capacities were determined by the contour method of survey. The significant data are listed in table 2.

Table 2.--Summary of results of detailed surveys of Bartel and Johnson stock ponds

Item	Bartel stock pond	Johnson stock pond
Age.......................................years..	1/ 29	2/ 25
Watershed area[3].........................acres..	390	122
Reservoir:		
Area at spillway stage:		
Original.................................do....	2.00	1.51
At date of survey........................do....	1.98	1.51
Storage capacity to spillway level:		
Original.........................acre-feet..	4.30	2.56
At date of survey........................do....	2.80	1.85
Capacity per sq. mile of drainage area:[3]		
Original.................................do....	7.06	13.41
At date of survey........................do....	4.60	9.70
Sedimentation:		
Total sediment...........................do....	1.50	0.71
Average annual accumulation:		
From entire drainage area................do....	0.05	0.03
Per acre of drainage area:[4]		
By volume.....................cubic feet..	5.8	10.3
By weight.............................tons..	5/0.16	6/ 0.30
Depletion of storage:		
Loss of original capacity:		
Per year..........................percent..	1.16	1.11
To date of survey........................do....	34.88	27.73

[1]Storage began 1908; average date of survey, June 1937.
[2]Storage began 1912; average date of survey, June 1937.
[3]Including pond area.
[4]Excluding pond area.
[5]Based on average dry weight of 53.6 pounds per cubic foot, determined from 3 samples (table 3).
[6]Based on average dry weight of 58.1 pounds per cubic foot, determined from 3 samples (table 3).

VOLUME-WEIGHT RELATIONS OF SEDIMENT

The results of laboratory determinations of the volume-weight relations of the sediment samples taken during the surveys of Hurley Lake and the two stock ponds are given in table 3.

Table 3.--Volume weights of sediment samples from Hurley Lake and Bartel and Johnson stock ponds

Sample Number	Dry weight per cubic foot of sediment[1]
	Pounds
Hurley Lake:	
1	44.6
2	47.0
3	40.3
4	43.3
5	29.2
Average	40.9
Bartel stock pond:	
1	50.1
2	49.6
3	61.0
Average	53.6
Johnson stock pond:	
1	55.3
2	55.3
3	63.7
Average	58.1

[1]Corrected for 0.61 percent moisture retained when dried to constant weight at 90° C.

It is to be noted that the average weight of sediment in the two stock ponds is greater than that in Hurley Lake. This is probably due to the fact that the stock ponds are dry several months each year, and the sediment becomes compacted by drying and by the trampling of cattle and horses. The sediment in Hurley Lake has never been exposed to such conditions. In view of the wide divergence in the average weight per cubic foot of sediment in the three basins, it is evident that accumulation by volume does not offer a complete index for comparison of rates of sedimentation. For this reason the conclusions of this report have been based upon annual accumulation in terms of the dry weight of silt per acre of drainage area.

CONCLUSION

If it is assumed that the average of conditions affecting erosion and deposition in the drainage areas above the Johnson and Bartel stock ponds is typical of that of the average stock pond, the average of the erosional-debris outputs of these two areas--0.23 ton per acre per year--should be representative of the 17 stock-pond drainage basins as a whole. On this assumption, the total amount of sediment carried annually into the 17 stock ponds from the estimated 8,550 acres draining into them is about 1,950 tons. If this sediment had been deposited in Hurley Lake the total storage depletion to the date of survey would have been about 3.59 percent instead of 3.02 percent.

It is difficult to determine, however, what proportion of this erosional debris would reach the main lake if it were not intercepted by the stock ponds. Assuming that the average rate of silting, as determined by detailed surveys on the two stock ponds, represents the average rate of erosion in the entire Hurley Lake drainage basin, it may be calculated that 10,275 tons of soil debris is set in motion through water erosion in the Hurley Lake drainage basin each year. This figure is at variance with the 9,250 tons of debris that has been computed as the combined yearly accumulation in Hurley Lake and the 17 stock ponds above it. In other words, the combined accumulation in Hurley Lake and the stock ponds leaves 1,025 tons of sediment per year apparently unaccounted for on this basis.

Some such discrepancy undoubtedly does exist, owing to one or all of the following factors: (1) a higher-than-average rate of sediment output in the small areas draining into the stock ponds; (2) less complete desilting of flood waters in Hurley Lake than in the stock ponds; and (3) deposition of erosional debris upstream

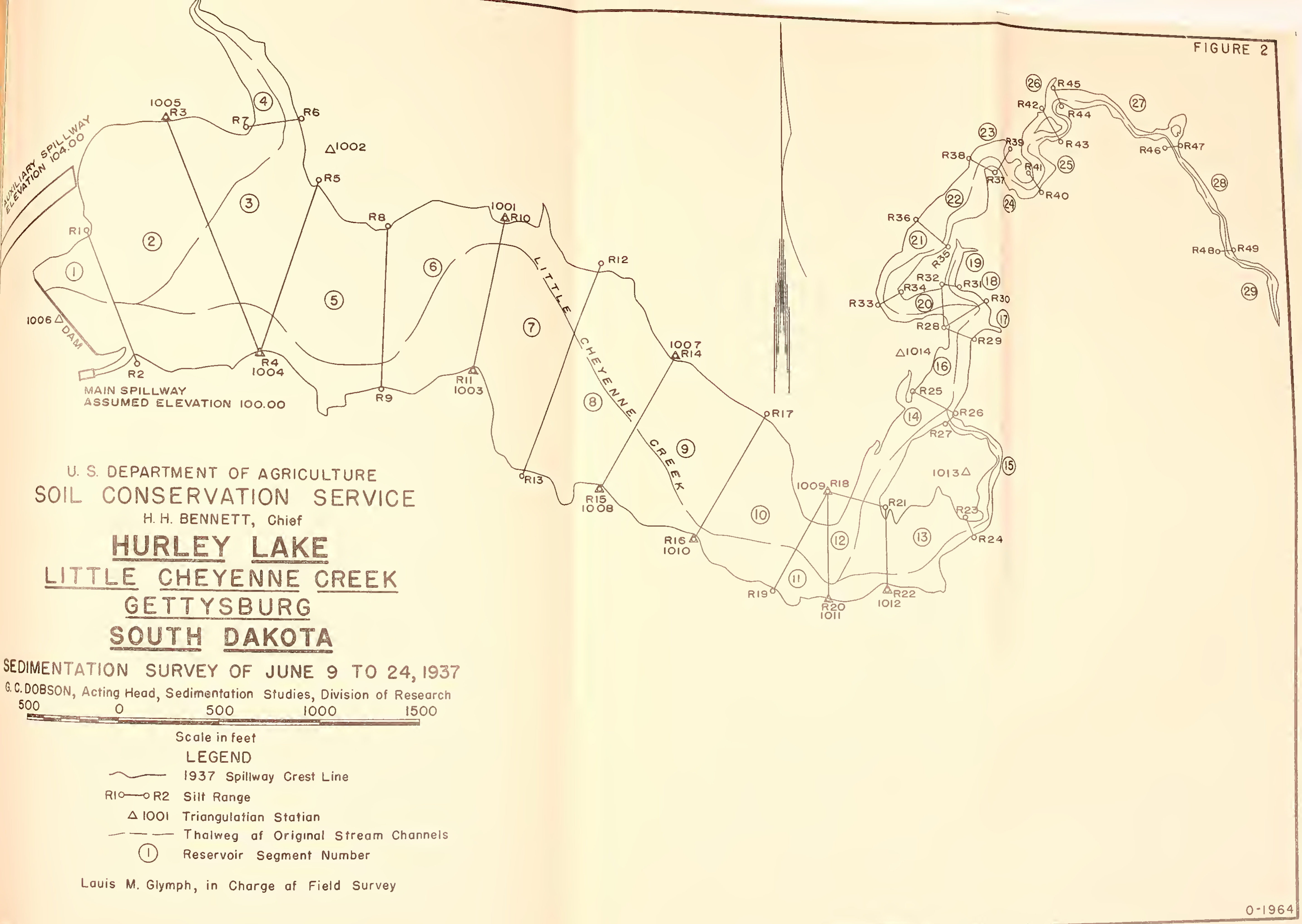
from Hurley Lake outside of areas draining into stock ponds, either as (a) colluvial deposits, (b) deposits in the channel of Little Cheyenne Creek and its several small tributaries, or (c) deposits on the small stream terraces adjacent to Little Cheyenne Creek and its several small tributaries. These factors are discussed below:

(1) Since the two stock ponds were selected as most representative of average conditions within the drainage basin, it appears that detailed conservation surveys of the entire Hurley Lake drainage area would be required to evaluate more completely the rates of erosion in the various parts of the area.

(2) A more complete desilting of flood waters flowing into the stock-pond storage basins seems improbable when we consider the relation of both original and remaining storage capacities to the size of the individual tributary drainage areas. This relation is expressed in the tabulation on page 9 and in table 2 under the heading "Capacity per square mile of drainage area." While the capacity-inflow ratio is low in each case, it is probable, considering the available storage space, that both Bartel's and Johnson's stock ponds bypass a considerably larger proportion of their incoming sediment load than the main lake. Furthermore, an unknown amount of sediment is undoubtedly bypassed through the Hurley Lake spillway, but, in view of the relatively small part of the time in which water is discharged from the lake, it seems probable that the total amount of sediment so discharged is comparatively low.

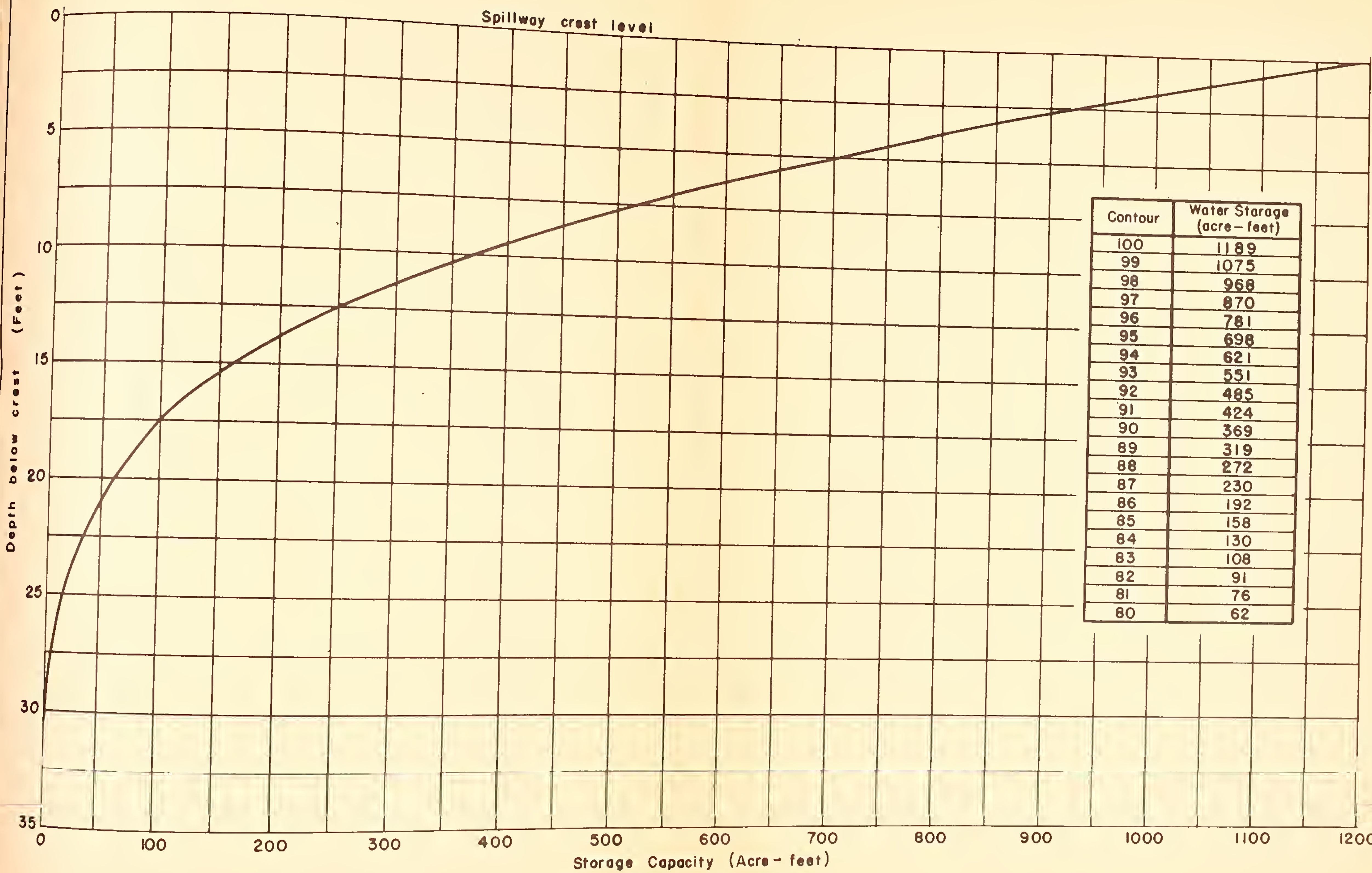
(3) Deposition upstream, at the base of slopes and along drainage channels, perhaps accounts for a major part of the apparent deficiency of debris in Hurley Lake. Instances of upstream deposition have been observed in various parts of the drainage basin, but the phenomenon is most pronounced in Fayette and Lowell Townships (fig. 1). In these localities debris drifts are common at the base of cultivated slopes and above road fills. Local and relatively small areas of sediment have also been observed in and adjacent to the stream channel in parts of Appomattox Township.

FIGURE 2



0-1964

Figure 3



Contour	Water Starage (acre – feet)
100	1189
99	1075
98	968
97	870
96	781
95	698
94	621
93	551
92	485
91	424
90	369
89	319
88	272
87	230
86	192
85	158
84	130
83	108
82	91
81	76
80	62

Figure 3- Storage Capacity Curve, June 1937, Hurley Lake, Gettysburg, S. D.

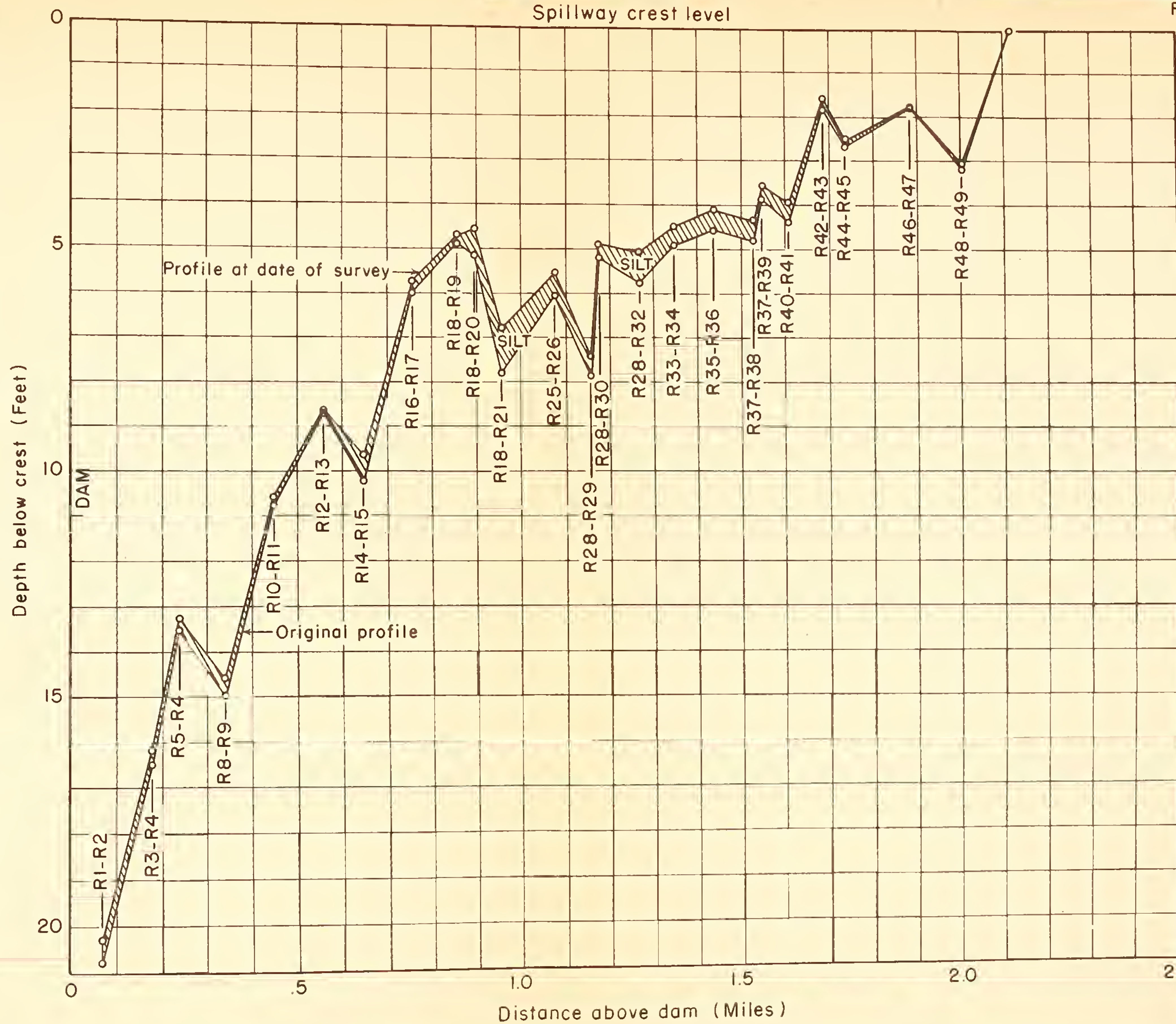
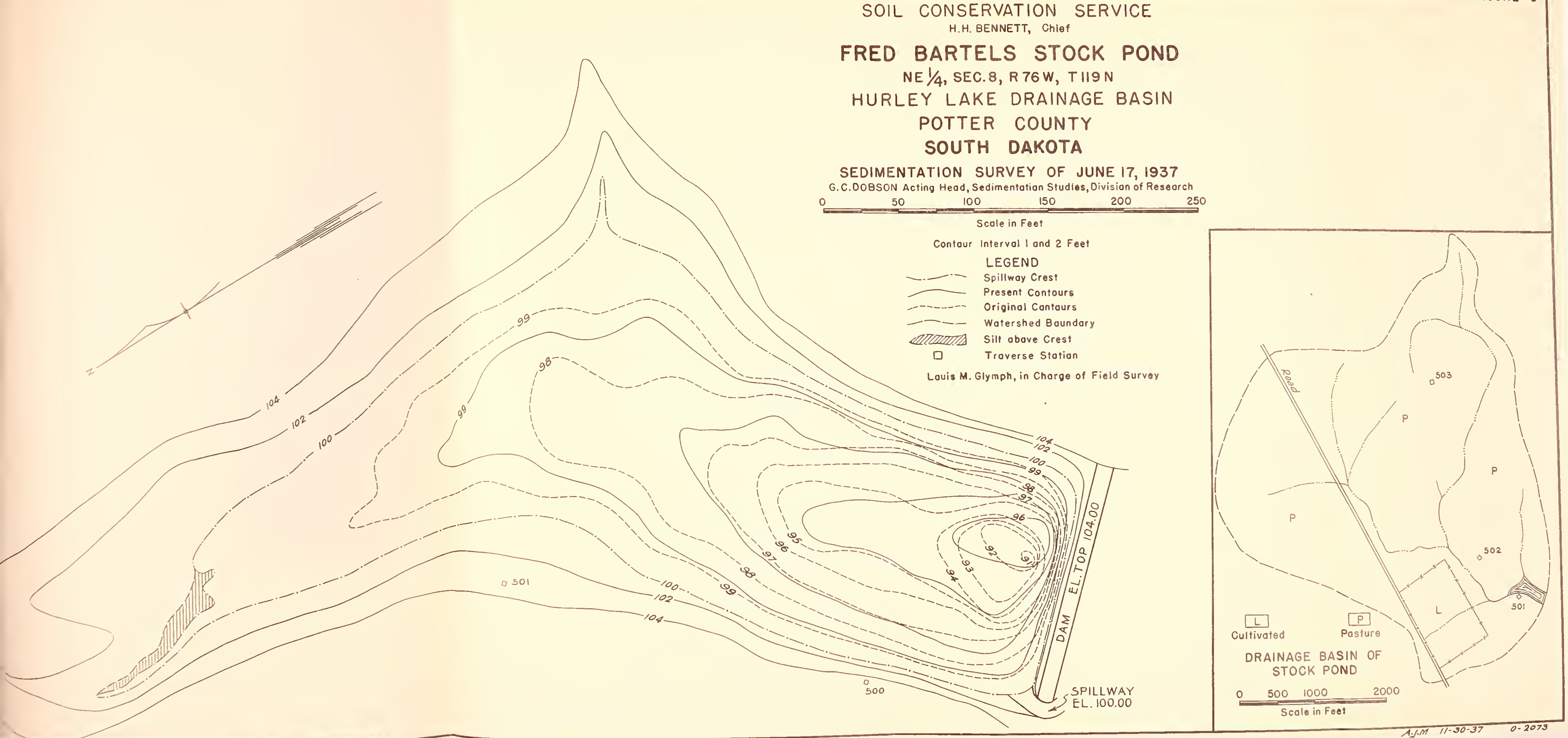


FIGURE 4.-Average-depth profiles, Hurley Lake, Gettysburg, South Dakota.

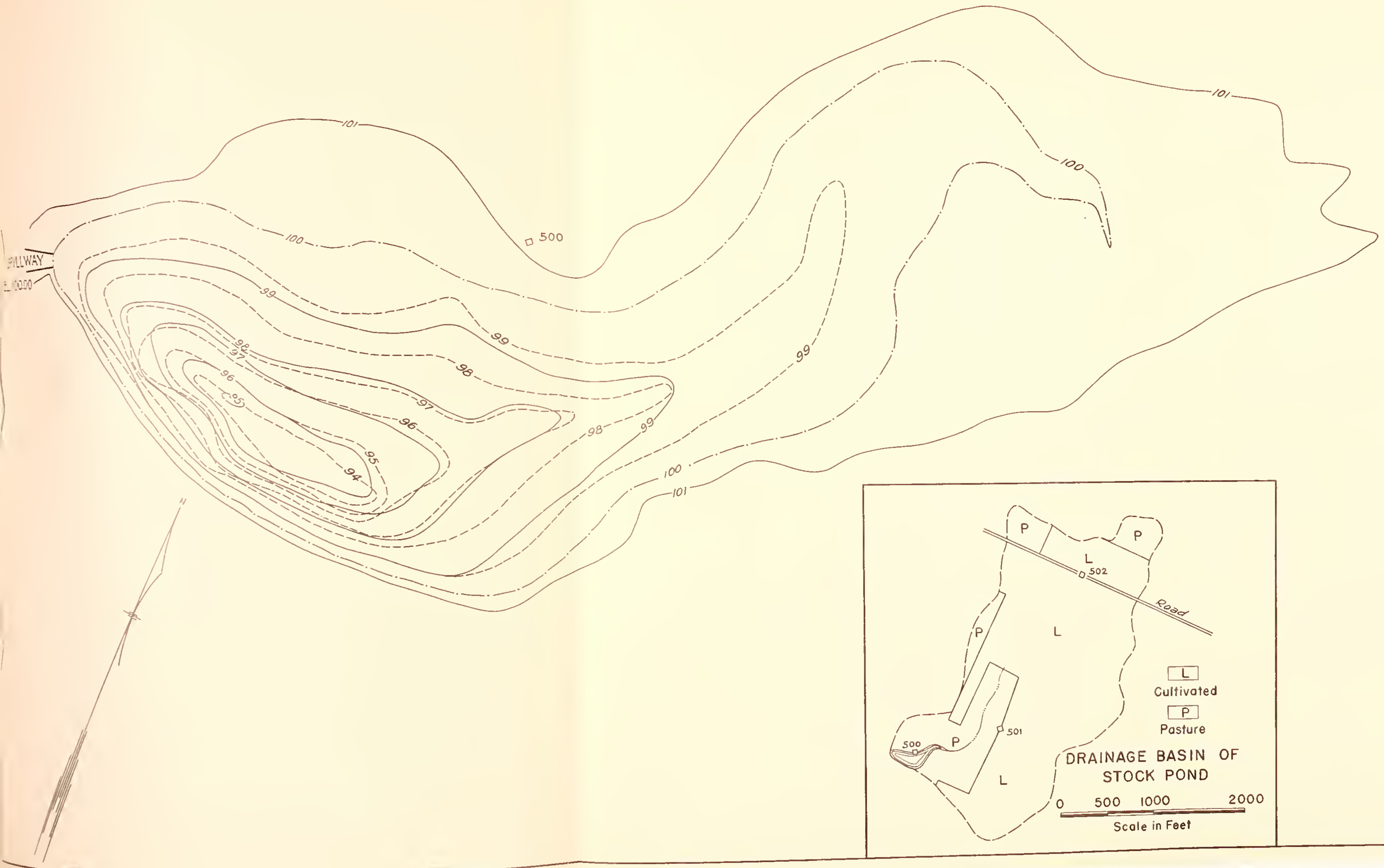
6-16-38 0-2239

FIGURE 5



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H.H. BENNETT, Chief
FRED BARTELS STOCK POND
NE 1/4, SEC. 8, R 76 W, T 119 N
HURLEY LAKE DRAINAGE BASIN
POTTER COUNTY
SOUTH DAKOTA
SEDIMENTATION SURVEY OF JUNE 17, 1937
G. C. DOBSON Acting Head, Sedimentation Studies, Division of Research
0 50 100 150 200 250
Scale in Feet
Contour Interval 1 and 2 Feet
LEGEND
Spillway Crest
Present Contours
Original Contours
Watershed Boundary
Silt above Crest
Traverse Station
Louis M. Glymph, in Charge of Field Survey
104
102
100
99
98
97
96
95
94
93
92
91
501
500
DAM EL. TOP 104.00
SPILLWAY EL. 100.00
N
Road
503
502
501
P
L
Cultivated
Pasture
DRAINAGE BASIN OF STOCK POND
0 500 1000 2000
Scale in Feet
A.J.M 11-30-37 0-2073

FIGURE 6



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. BENNETT, Chief

RALPH JOHNSON'S STOCK POND

NE 1/4, SEC. 26, R 77 W, T 120 N

HURLEY LAKE DRAINAGE BASIN
POTTER COUNTY
SOUTH DAKOTA

SEDIMENTATION SURVEY OF JUNE 21-22, 1937

G. C. DOBSON Acting Head, Sedimentation Studies, Division of Research

0 50 100 150 200 250
Scale in Feet

Contour Interval 1 Foot

LEGEND

Spillway Crest
Present Contours
Original Contours
Watershed Boundary

Traverse Station

Louis M. Glymph, in Charge of Field Survey

A.J.M. 11-26-37 0-2067

Little

[illegible]
[illegible] Conservation Service
U. S. Department of Agriculture
Washington, D. C.